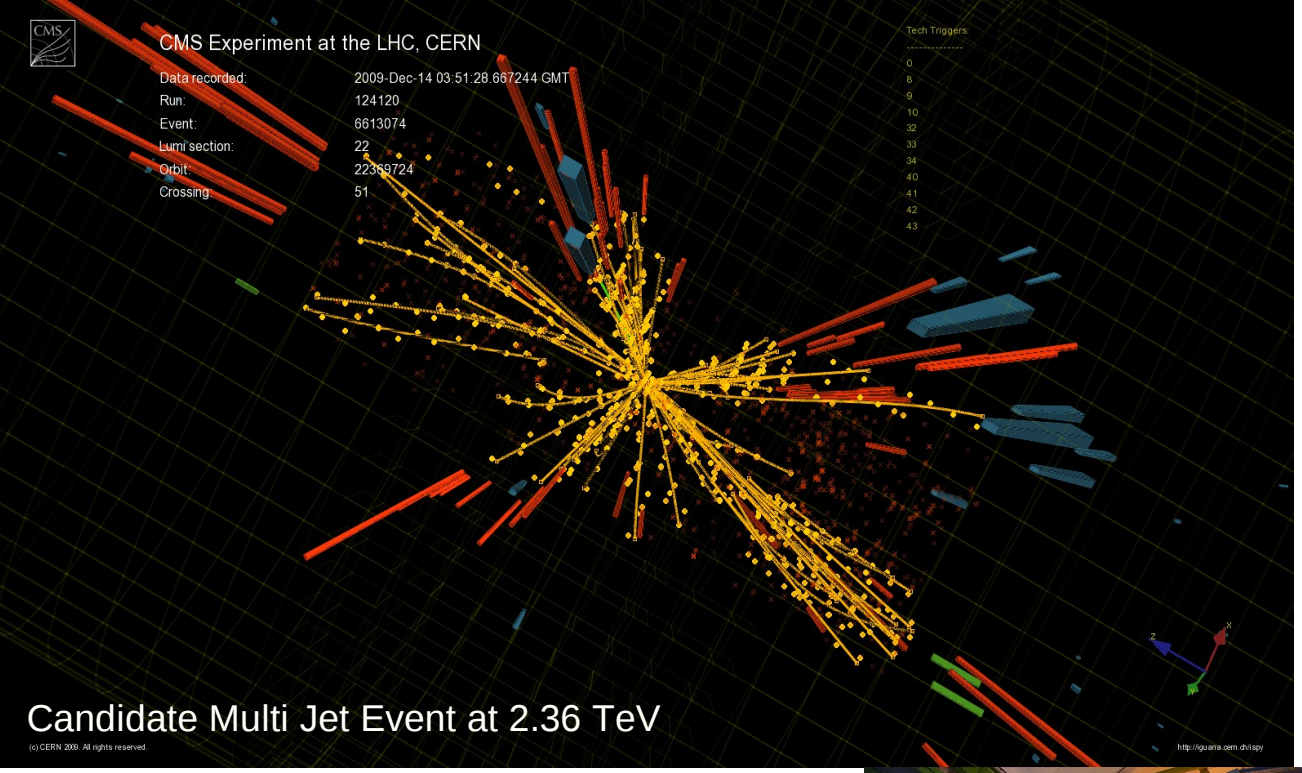


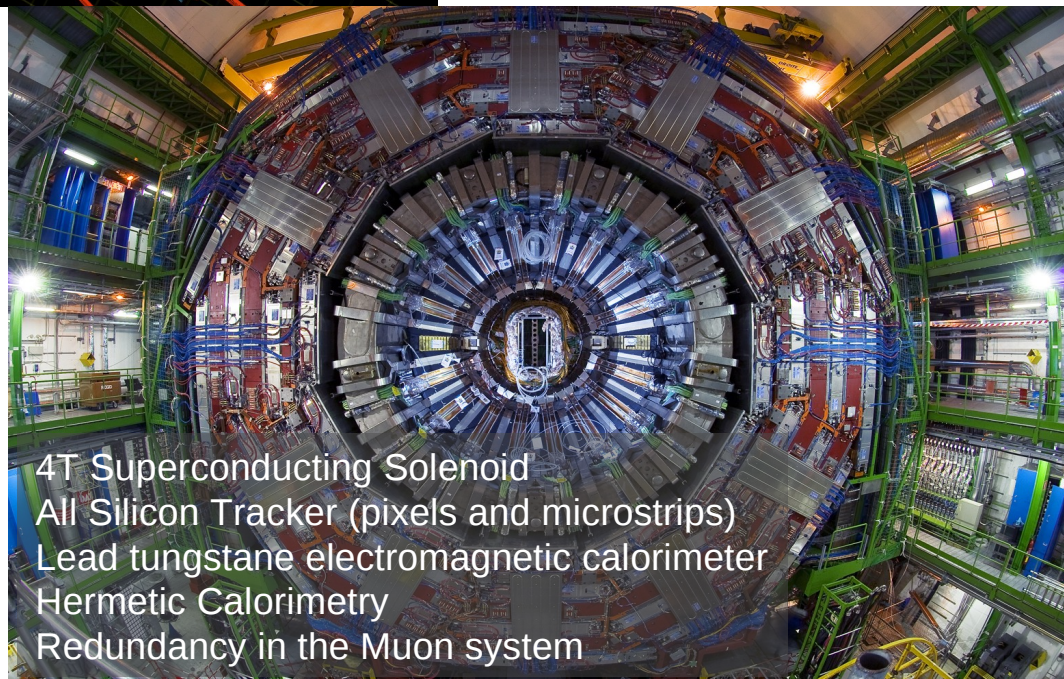
Note:

- This talk: focus more on the operation side of the last 26 days of LHC/CMS, 2009
- Jan. AEM CMS report: more results + data operation
- Jan. 6th, Colloquium by Sara Eno, “CMS Physics Results”
- EJTerm Jan. 5-9 at the LPC, CMS tutorial/lectures
- Jan. 8, W/C seminar, more on CMS by Marat

CMS & LHC Update

Kaori Maeshima (Fermilab)
For the CMS Collaboration

December 21, 2009
All Experimenters' Meeting



Summary

LHC has conducted successful 2009 commissioning operation

- 900 GeV collisions (injection energy),
- multiple bunches (16 on 16)
- Ramp up & 2.36 TeV collisions, 4 on 4, squeezed to 7m

CMS has started taking collision data

On the average more than 99% of the sub-detector electronic channels are operational. High data-taking efficiency (> 80% for “quiet” or “stable beam” flag (all CMS ON))

All indications are that:

- data can be analysed rapidly – all chains are working well,
- the performance is according to design (almost all distributions agree well with the simulations at the fine level),
- CMS is starting to produce results from collision data.

Timeline: LHC & CMS Nov-Dec '09

- **Nov 7-9:** Beam Shots onto collimators near CMS (*"splashes"*)
  - CMS took data with calorimeters on, Solenoid off.
- **Nov 20:** Both beam *circulated* (individually) at injection E = 450 GeV
  - CMS took data with calorimeters on, Solenoid off.
- **Nov 30:** CMS solenoid ramped to 3.8 T. LHC Ramp test up to 1.18 TeV.
- **Dec 4:** Injection of first *multi-bunch beam*
- **Dec 6:** 4 bunch x 4 bunch *first collisions* at 900 GeV (~5e9 protons/bunch)
  - CMS took data with
    - All detectors ON, including silicon tracker and pixels
    - Magnetic field ON

→ **Dec 7:** LHC/CMS status report at AEM, by Aron Soha

- **Dec 10:** 2 Fills (58, 70 min), *900 GeV Collisions*
- **Dec 11:** 3 Fills (268, 200, 161 min), *900 GeV Collisions* (~7e10 protons per beam)
- **Dec 12:** 4 Fills (140, 219, 297, 121 min), *900 GeV Collisions*
- **Dec 14:** Fill#916 (03:06 – 04:54 UTC) *first 2.36 TeV collisions recorded at CMS*
- **Dec 14:** Fill#919 (72 min), *900 GeV Collisions (16x16)*
- **Dec 16:** Fill#923, more 2.36 TeV collisions, *squeeze* (11 → 7m),
  - CMS observed minbias trigger rate: below 2 Hz → ~ 3 Hz.

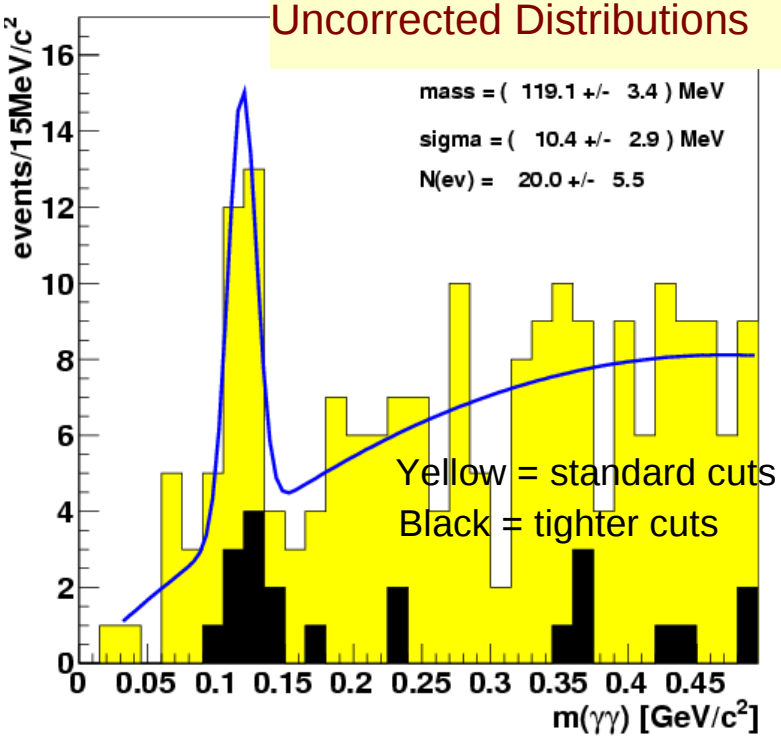
Di-photon Resonance: π^0

Shown on Dec. 7th (AEM)

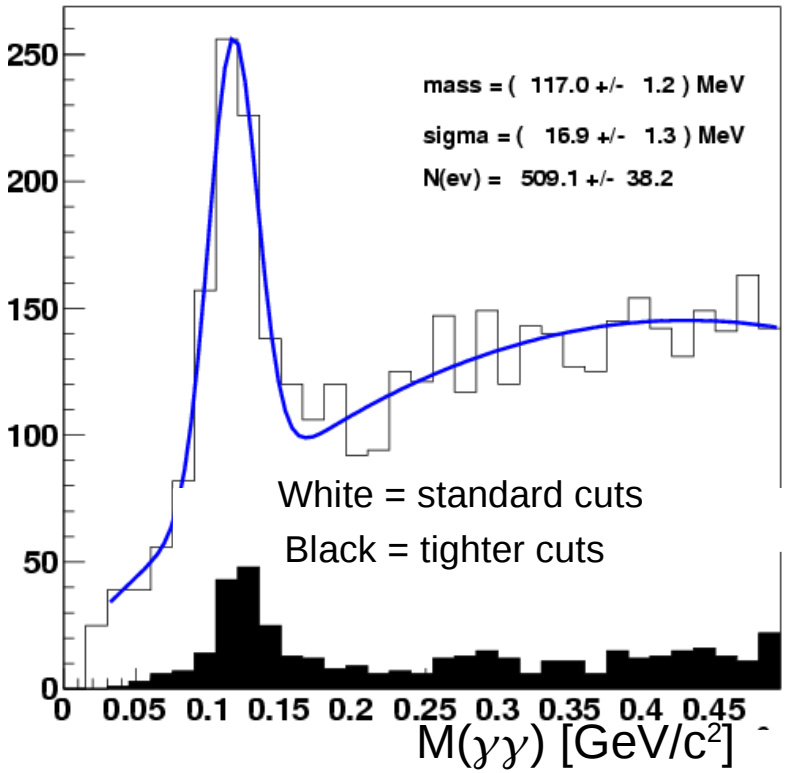
- Minimum bias trigger (191 events)
- Selection: 3x3 crystals; $E_T(\gamma) > 300$ MeV; $E_T(\pi^0) > 900$ MeV; shower shape

Data

CMS 2009 Preliminary
Uncorrected Distributions



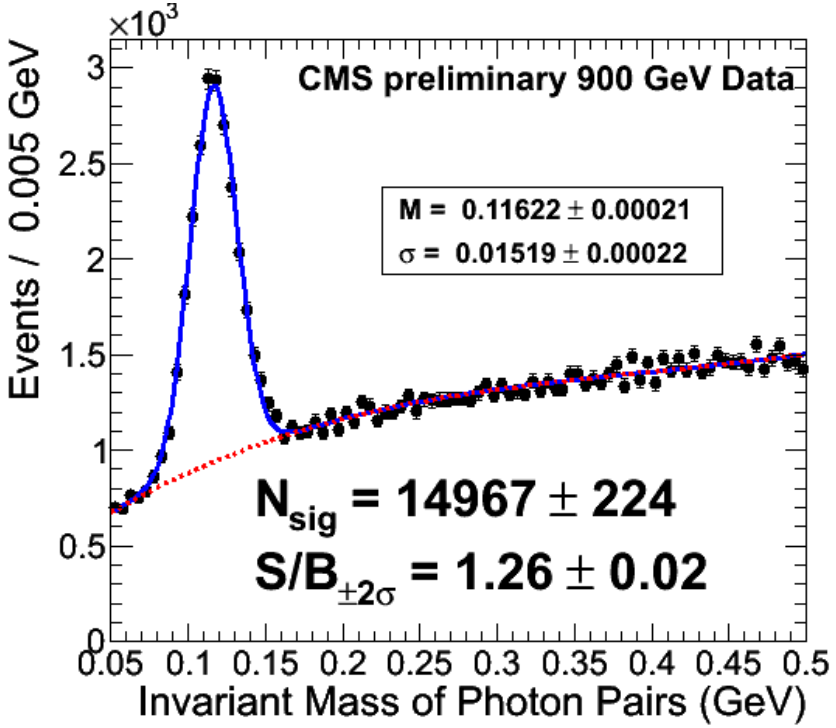
MC

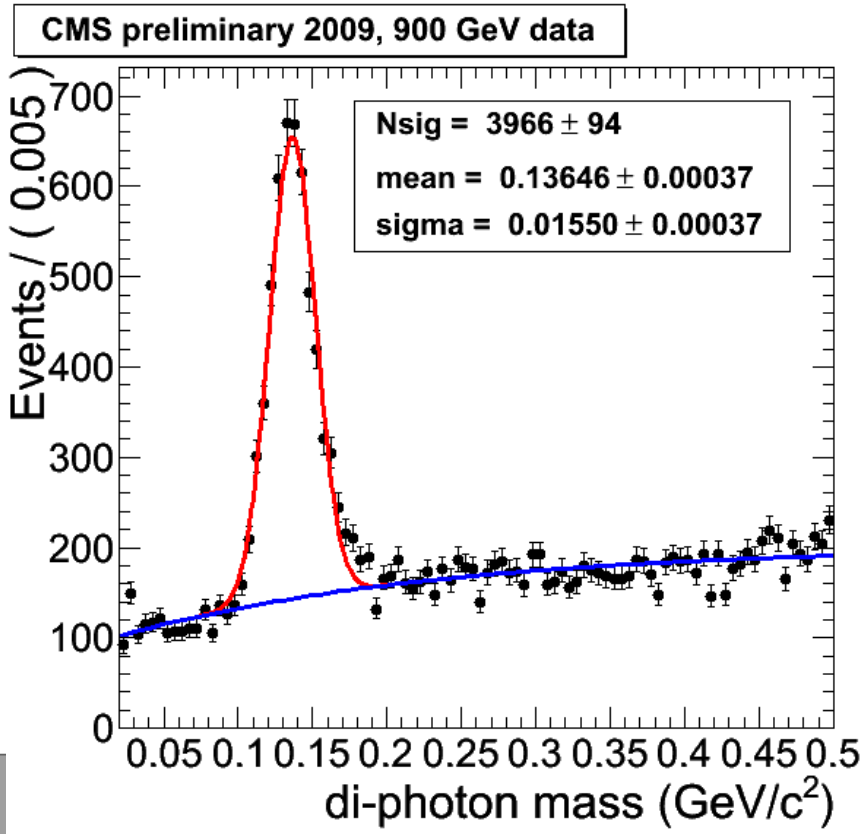


- $M(\pi^0)$ is low in both data and MC
  - Mostly due to readout threshold of 100 MeV / crystal
  - Also, part of energy is deposited upstream of ECAL due to conversions

Di-photon Distribution in CMS

From: Dec. 18th

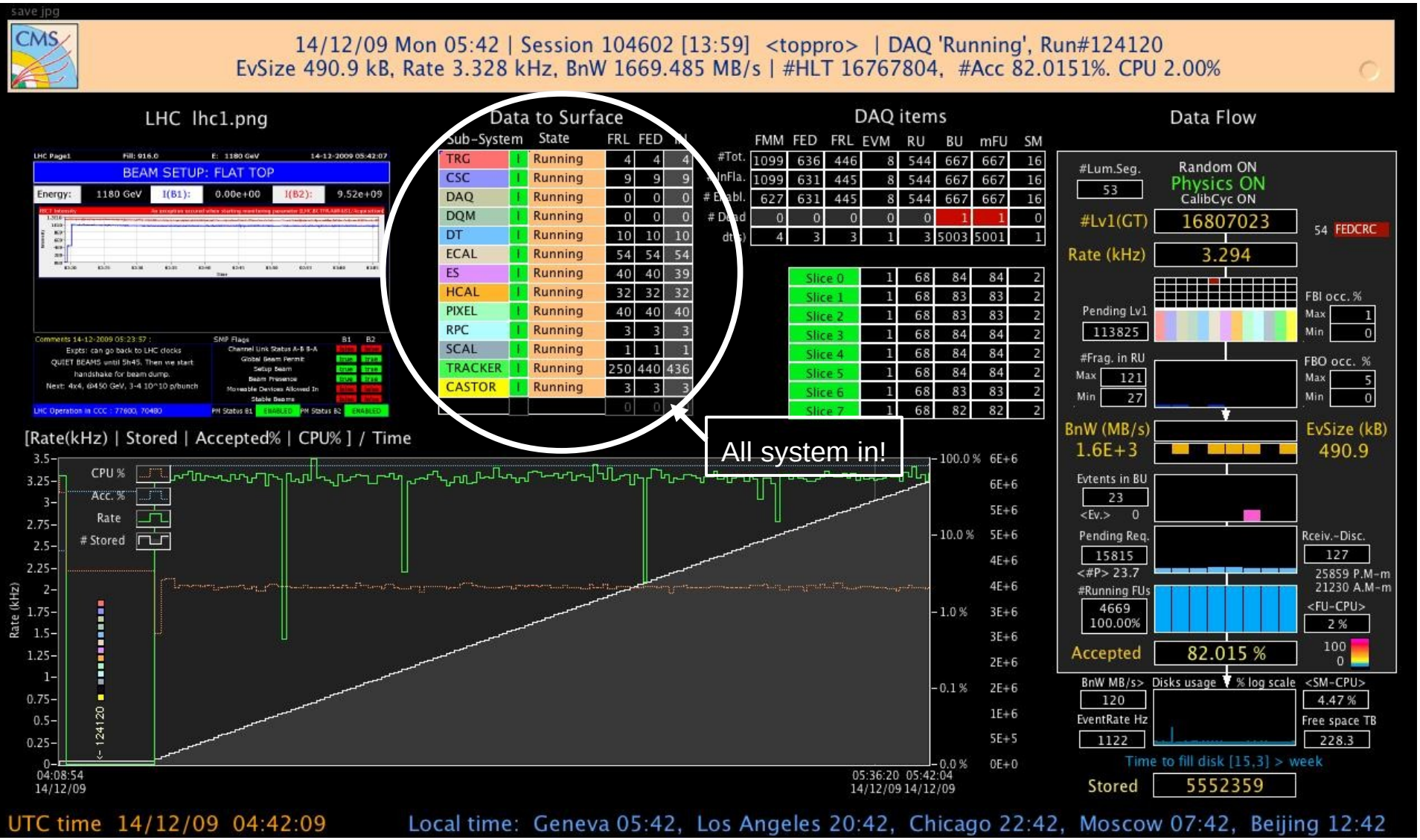




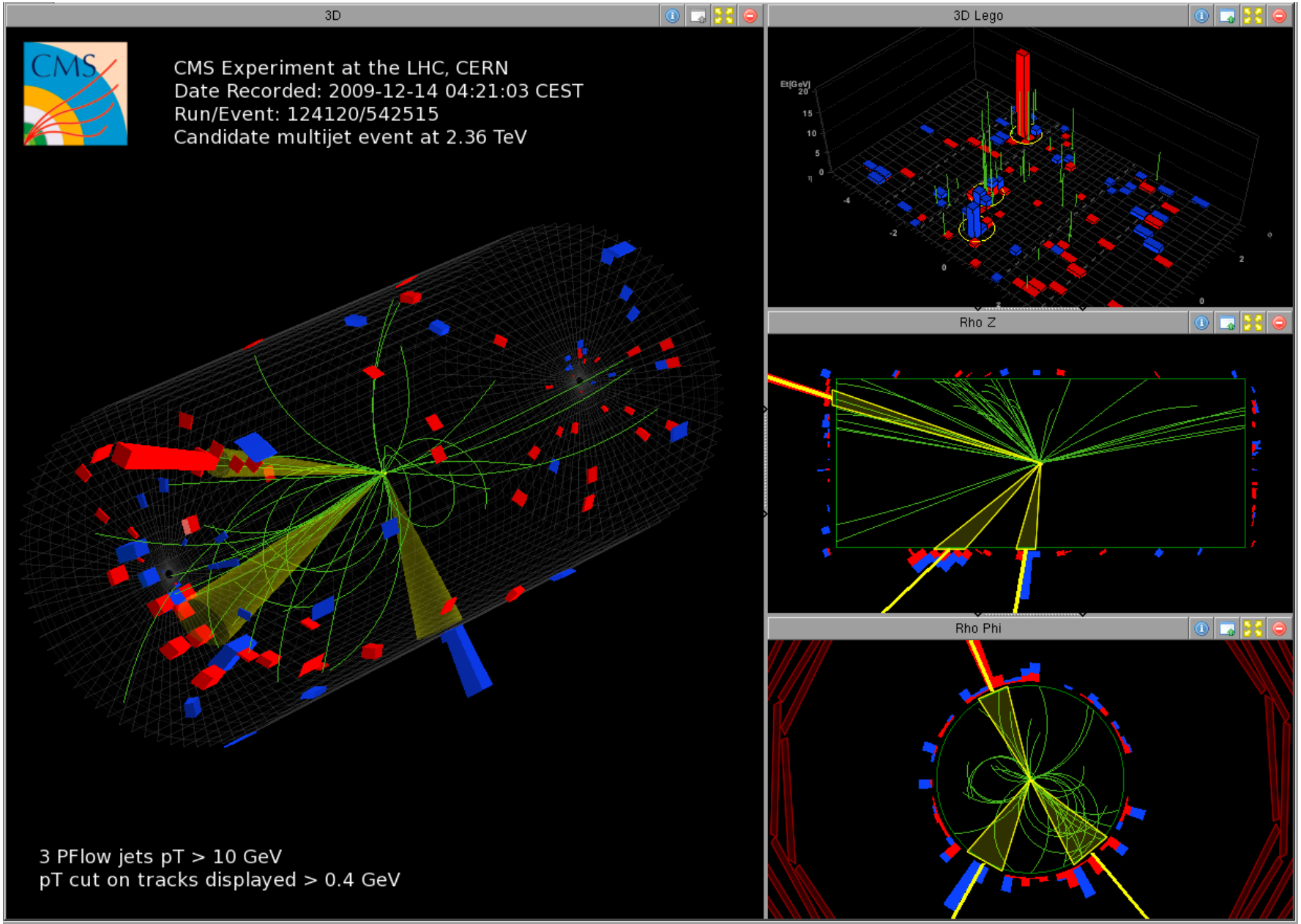
- **Data and MC comparison (uncorrected distributions)**
- Almost identical S/B, mass and width compatible
- M(π^0) is low in both data and MC - Mostly due to the readout threshold (100 MeV/Crystal) and conversions

Using "out of the box" corrections

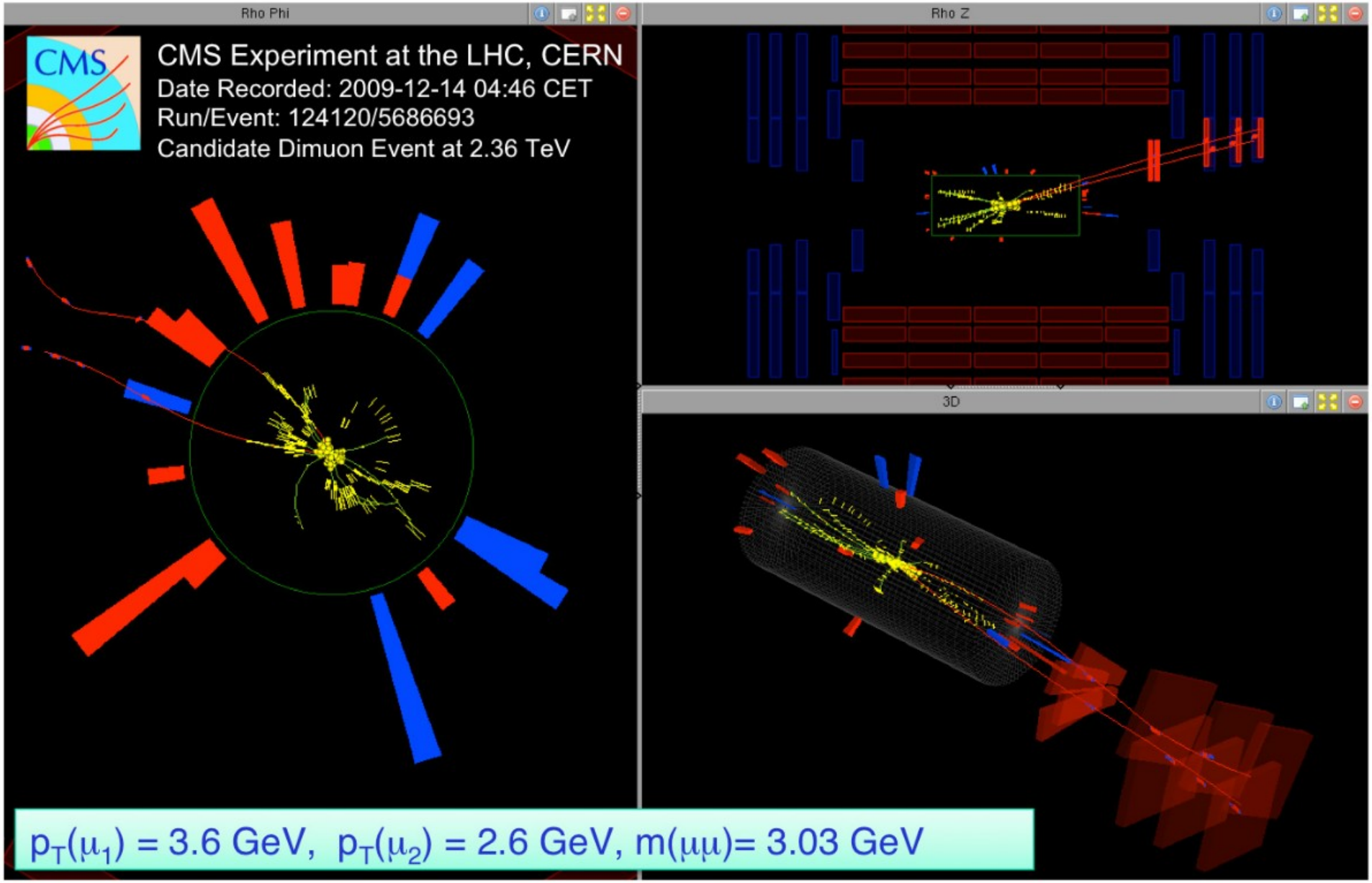
Stable Colliding Beam and CMS DAQ Display



Calorimeters



Muons: A Dimuon Event at 2.36 TeV



Rapid Analysis

Sunday 6th Early Morning: First "Physics" Fill

4x4 bunches, Σ ~ e10 protons, Stable Beam Flag set for the first time

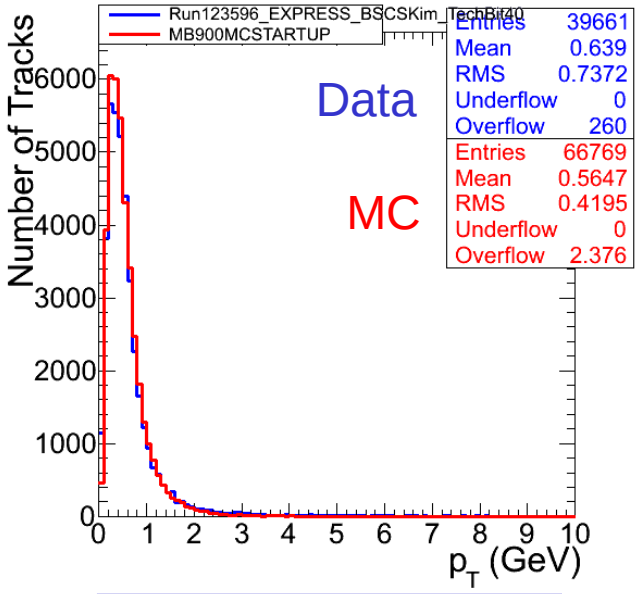
All of CMS was Switched ON

Sunday 6th : 9am

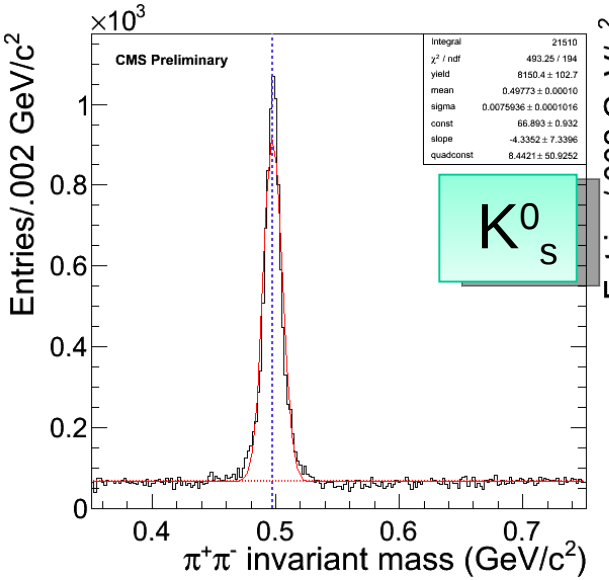
LHC Run Meeting

Monday 7th : First K^0_S & Λ

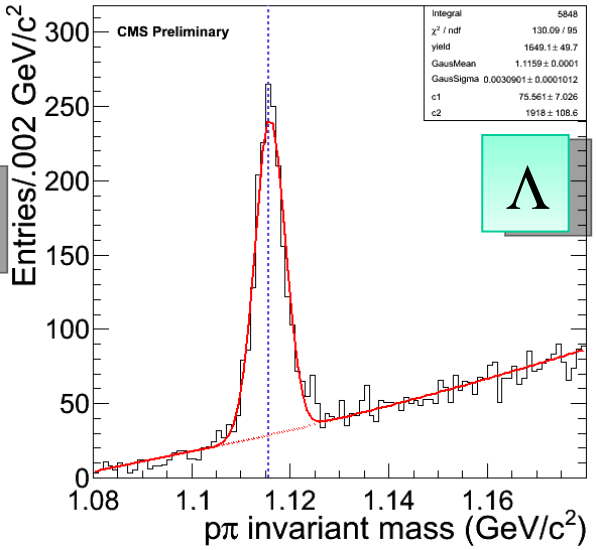
CMS 2009 Preliminary



Charged particle p_T spectrum



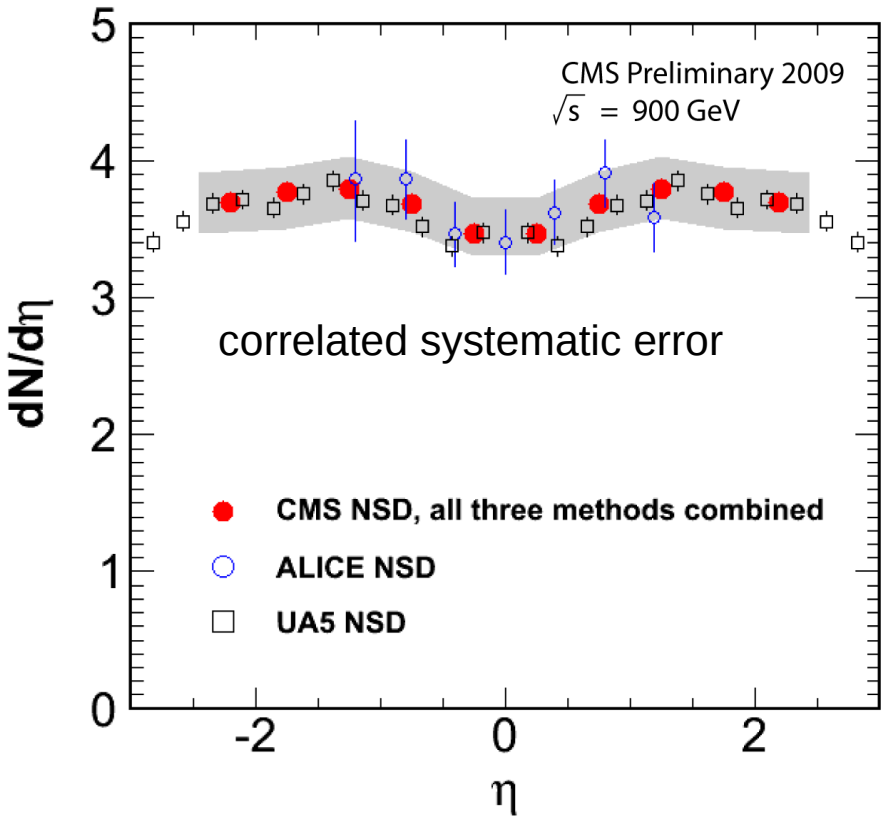
M=497.7 MeV/c², σ=7.6 MeV/c²



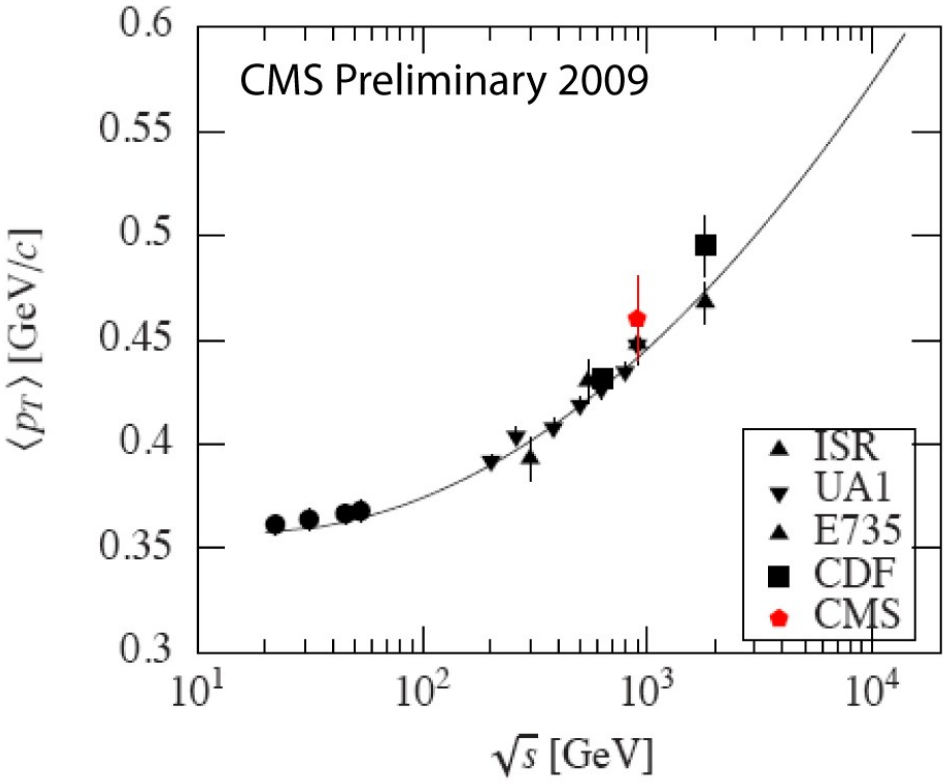
M=1.116 GeV/c², σ=3.1 MeV/c²

First Physics Distributions

Charged Particle Multiplicity



Average p_T



LHC Commissioning 2009

https://cern.ch/lpc

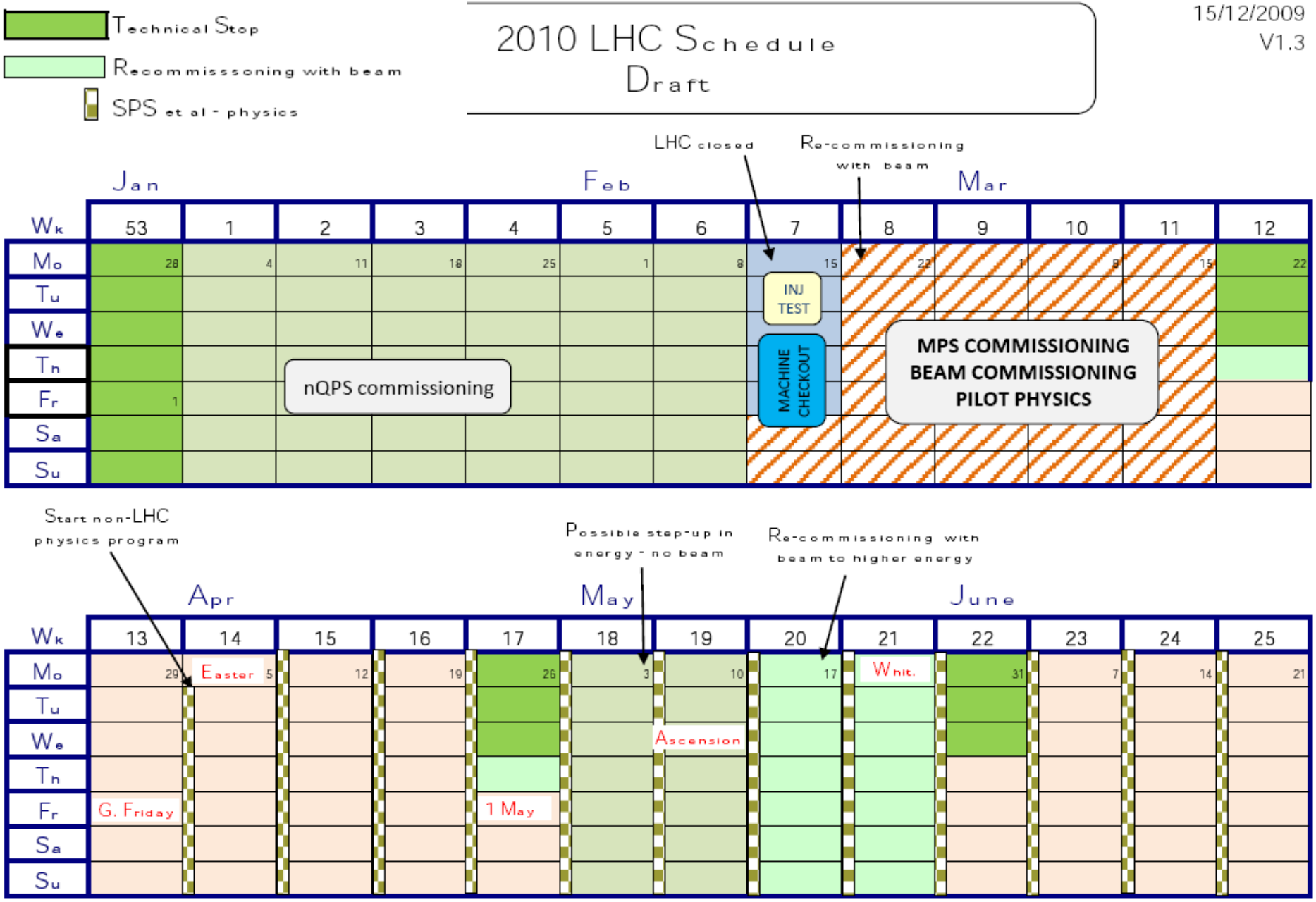
Friday November 20th	Injection of both beams - rough RF capture	
Saturday November 21st	Beam 1 circulating	- lifetime 10 hours
Sunday November 22nd	Beam 2 circulating	- lifetime 3 hours
Monday November 23rd	First pilot collisions at 450 GeV First trial ramp (lost 560 GeV - tunes)	tune feedback on 1 beam
Tuesday November 26th	Precycle established Energy matching between SPS & LHC	
Sunday November 29th	Ramp to 1.07 TeV and then 1.18 TeV (00:43 Monday)	Tune PLL commissioned
Monday 30th November	Solenoids on	Coupling & orbit compensated
Tuesday 1st - Sunday 6th December	Aperture, collimation and beam dump studies continued - protection qualified to a sufficent level at 450 GeV to allow "stable beams" to be declared.	
Sunday 6th	06:55 Stable beams at 450 GeV - 4 on 4 pilot intensities	Initial struggle with vertical tune
Tuesday 8th December	Ramp 2 on 2 - lost one beam after 3 minutes - but first collisions in Atlas (21:40) at 1.18 TeV	No logging - suspect loss due tune swing at end of ramp
Friday 11th December	(01:30) Stable beam collisions at 450 GeV with high bunch intensities: 4 x 2 10^10 per beam	
Monday 14th December	Ramp 2 on 2 to 1.18 TeV - quiet beams - collisons in all four experiments	
Monday 14th December	16 on 16 at 450 GeV - stable beams	
Wednesday 16th December	Ramped 4 on 4 to 1.18 TeV - squeezed to 7 m in IR5 - collisions in all four experiments	Step 1: to collision tunes Step 2: to 9 m Step 3: to 7 m
Wednesday 16th December	18:00 End of run	

End of year Technical Stop

A technical stop is needed to prepare the LHC for higher energy running in 2010. Before the 2009 running period began, all the necessary preparations to run up to a collision energy of 2.36 TeV had been carried out. To run at higher energy requires higher electrical currents in the LHC magnet circuits. This places more exacting demands on the new machine protection systems, which need to be readied for the task. Commissioning work for higher energies will be carried out in January, along with necessary adaptations to the hardware and software of the protections systems that have come to light during the 2009 run. Taking advantage of the stop, the CMS experiment will upgrade part of its water cooling system.

CMS Water Cooling Issue:

- Several water leak incidents were found.
- Cause of the problem was traced to be “stress corrosion” of bushings used in the water cooling system in the endcap region.
- ~400 of such bushings are used and only < 30% can be accessed with the detector closed.
- Decision was made to open the detector for repair/upgrade during the winter LHC technical stop.


Technical Stop
Recommisssoning with beam
SPS et al - physics
2010 LHC Schedule
Draft
15/12/2009
V1.3
LHC closed
Re-commissioning with beam
Jan
Feb
Mar
Wk
53
1
2
3
4
5
6
7
8
9
10
11
12
Mo
Tu
We
Th
Fr
Sa
Su
28
4
11
18
25
1
8
15
22
1
8
15
22
1
INJ TEST
MACHINE CHECKOUT
nQPS commissioning
MPS COMMISSIONING
BEAM COMMISSIONING
PILOT PHYSICS
Start non-LHC physics program
Possible step-up in energy - no beam
Re-commissioning with beam to higher energy
Apr
May
June
Wk
13
14
15
16
17
18
19
20
21
22
23
24
25
Mo
Tu
We
Th
Fr
Sa
Su
29
Easter
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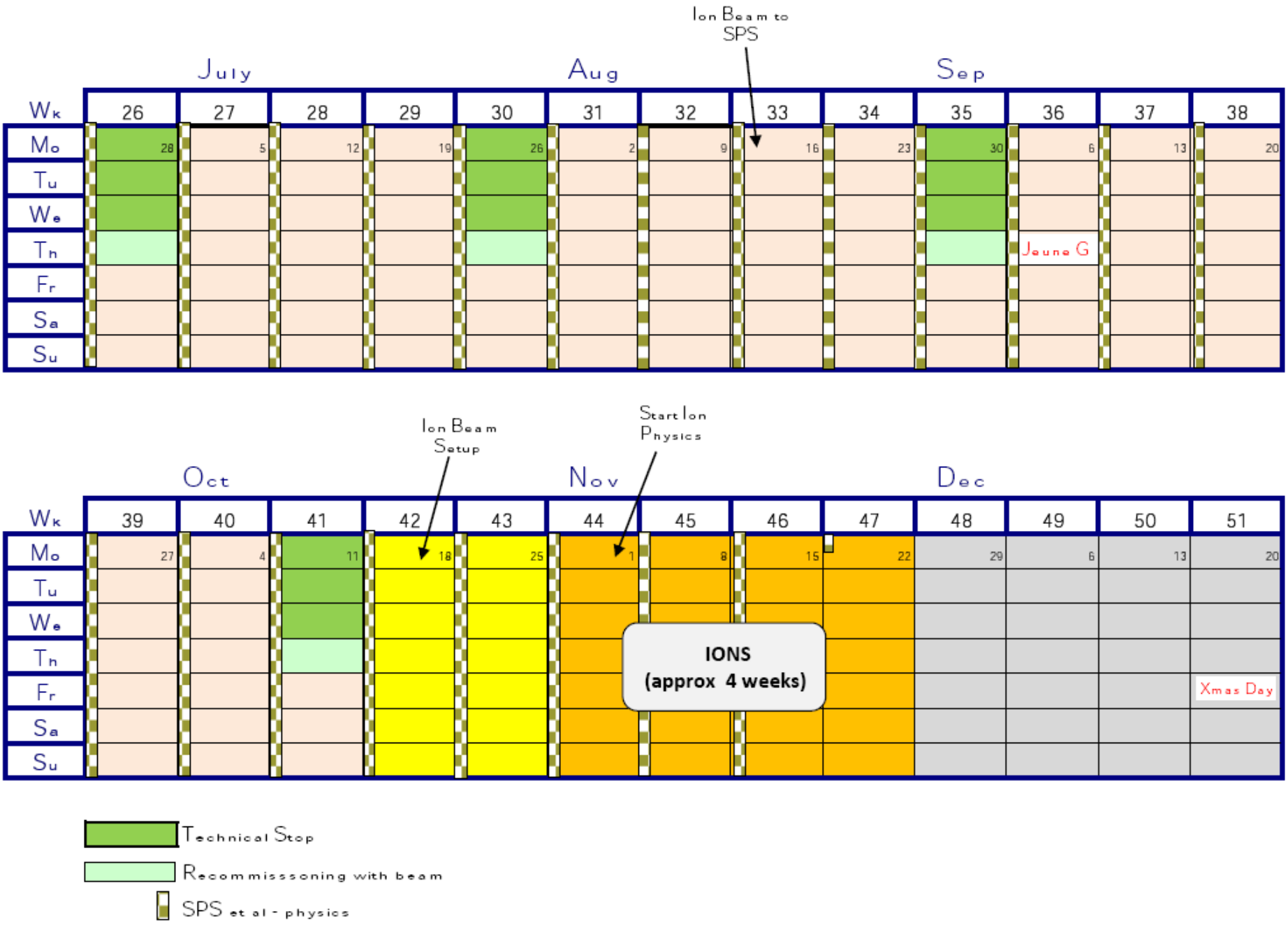
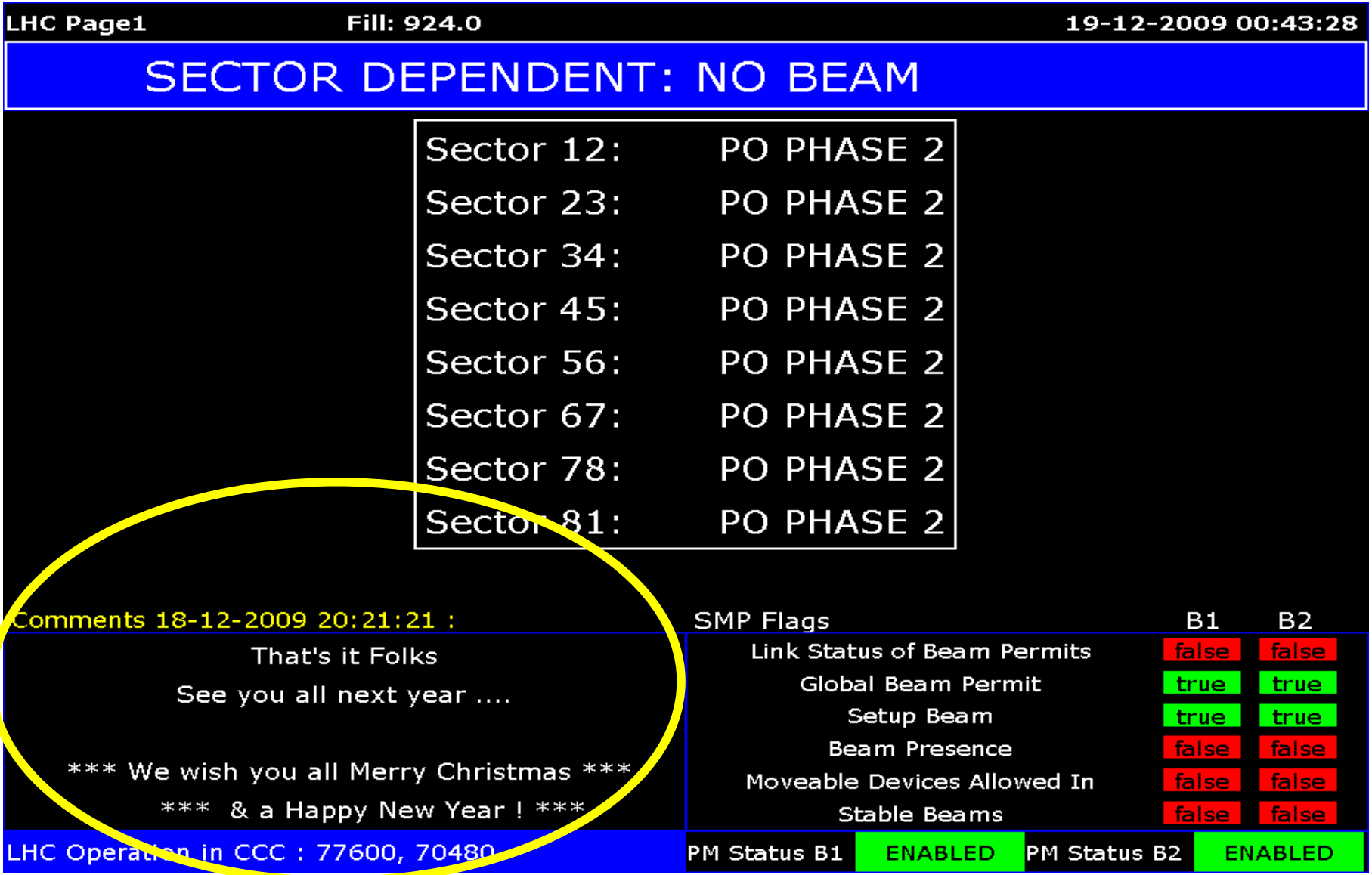
17
Whit.
31
7
14
21
Ascension
G. Friday
1 May


Ion Beam to SPS
July
Aug
Sep
Wk
26 27 28 29 30 31 32 33 34 35 36 37 38
Mo
Tu
We
Th
Fr
Sa
Su
28 5 12 19 26 2 9 16 23 30 6 13 20
Jeune G
Ion Beam Setup
Start Ion Physics
Oct
Nov
Dec
39 40 41 42 43 44 45 46 47 48 49 50 51
27 4 11 18 25 1 8 15 22 29 6 13 20
IONS
(approx 4 weeks)
Xmas Day
Technical Stop
Recommisssoning with beam
SPS et al - physics

So.....

- LHC has done very well in 2009, meeting all the milestones set earlier in the year.
- CMS has finally recoded LHC collision data and ready for much more!!!!
- At FNAL, ROC (remote operation center) have been extremely active, taking real time CMS official shifts and contributing to the central operation in multiple ways.
- We have lots to look forward to, in 2010.



Note (upcoming!):

- •. Jan. AEM CMS report: more results + data operation.
- •. Jan. 6th, Colloquium by Sara Eno, Jan. 8th, W/C seminar by Marat Gataullin

Backup slides

(Main) physics run conditions